

## **CLAIMS**

### **WHAT IS CLAIMED IS:**

1. A hand-held laser fusion welding torch system, comprising:
  - a body having a first end and a second end, the body first end adapted to couple to a laser beam delivery system;
  - a handle coupled to the body and dimensioned to be grasped by a hand;
  - a nozzle coupled to the body second end, the nozzle having an aperture through which a laser beam from the laser beam delivery system may pass; and
  - an independent off-axis filler media feed assembly that provides for independent manipulation and control of the laser beam and metal powder.
2. The torch system of Claim 1, wherein the independent off-axis filler media feed assembly is operable independent of the laser beam.
3. The torch system of Claim 1, further comprising:
  - a filler media supply system coupled to the filler media feed assembly and operable to supply the filler media feed assembly with filler media.
4. The torch system of Claim 1, wherein the independent off-axis filler media feed assembly further comprises:
  - a gas flow delivery system operable to transmit gas to an operating site of the torch.
5. The torch system of Claim 1, further comprising:
  - a removable gas cover adapted to detachably couple to the nozzle, the gas cover having an aperture through which the laser beam from the laser beam delivery system may pass when the gas cover is coupled to the nozzle.
6. A hand-held laser fusion welding torch system, comprising:
  - a body having a first end and a second end, the body first end adapted to couple to a laser beam delivery system;

a handle coupled to the body and dimensioned to be grasped by a hand;  
a nozzle coupled to the body second end, the nozzle having an aperture about a first axis through which a laser beam from the laser beam delivery system may pass; and  
a filler material nozzle assembly operable to supply filler media along a direction that is not aligned with the first axis,  
wherein the laser beam and the feed assembly are configured such that each may be manipulated and controlled independent of one another.

7. The torch system of Claim 6, wherein the independent off-axis filler media feed assembly is operable independent of the laser beam.

8. The torch system of Claim 6, further comprising:  
a filler media supply system coupled to the filler media feed assembly and operable to supply the filler media feed assembly with filler media.

9. The torch system of Claim 6, wherein the independent off-axis filler media feed assembly further comprises:  
a gas flow delivery system operable to transmit gas to an operating site of the torch.

10. The torch system of Claim 6, further comprising:  
a removable gas cover adapted to detachably couple to the nozzle, the gas cover having an aperture through which the laser beam from the laser beam delivery system may pass when the gas cover is coupled to the nozzle.

11. A hand-held laser fusion welding torch system, comprising:  
a body having a first end and a second end, the body first end adapted to couple to a laser beam delivery system;  
a handle coupled to the body and dimensioned to be grasped by a hand;  
a nozzle coupled to the body second end, the nozzle having a nozzle aperture through which a laser beam from the laser beam delivery system may pass; and  
an annular powder delivery orifice arrangement formed in the nozzle.

12. The torch system of Claim 11, wherein:  
the nozzle includes at least an end surface and an outer surface; and  
the annular powder delivery orifice arrangement comprises:  
one or more powder delivery channels extending between an inlet port formed in the nozzle outer surface and an outlet port formed in the nozzle end surface, and  
an annular channel formed in the nozzle end surface and surrounding the nozzle aperture, the annular channel configured to provide fluid communication between each of the filler material supply channel outlet ports.
13. The torch system of Claim 11, further comprising:  
a removable gas cover adapted to detachably couple to the nozzle, the gas cover having an aperture through which the laser beam from the laser beam delivery system may pass when the gas cover is coupled to the nozzle.
14. The torch system of Claim 11, further comprising:  
a gas flow delivery system coupled to the removable gas cover.
15. The torch system of Claim 11, further comprising:  
a powder supply system coupled to the annular powder delivery orifice arrangement and operable to supply filler media to the filler media feed assembly.
16. A hand-held laser fusion welding torch system, comprising:  
a body having a first end and a second end, the body first end adapted to couple to a laser beam delivery system;  
a handle coupled to the body and dimensioned to be grasped by a hand;  
a nozzle having a first end, a second end, and an outer surface, the nozzle first end coupled to the body second end, the nozzle second end including an aperture through which a laser beam from the laser beam delivery system may pass;  
one or more filler material supply channels extending between an inlet port formed in the nozzle outer surface and an outlet port formed in the nozzle second end; and

an annular channel formed in the nozzle second end and surrounding the nozzle aperture, the annular channel configured to provide fluid communication between each of the filler material supply channel outlet ports.

17. The torch system of Claim 16, further comprising:

a removable gas cover adapted to detachably couple to the nozzle, the gas cover having an aperture through which the laser beam from the laser beam delivery system may pass when the gas cover is coupled to the nozzle

18. The torch system of Claim 17, further comprising:

a gas flow delivery system coupled to the removable gas cover.

19. The torch system of Claim 16, further comprising:

a powder supply system coupled to the annular powder delivery orifice arrangement and operable to supply filler media to the filler media feed assembly.

20. A method of treating a surface of a workpiece using a hand-held laser welding torch, the method comprising the steps of:

directing a laser beam through the torch and onto the workpiece surface, to thereby create a melt pool on the workpiece surface;

supplying filler material from a filler material source to the melt pool; and

manually manipulating the torch and filler material source.

21. The method of Claim 20, wherein the torch and filler material source are manually manipulated independent of one another.

22. The method of Claim 20, wherein the torch is manually manipulated using a handle that is coupled to the torch and dimensioned to be grasped by a hand.

23. The method of Claim 22, wherein:

the torch is manually manipulated by a first hand of a user; and

the filler material source is manually manipulated by a second hand of the user.

24. The method of claim 22, wherein the filler material being manual manipulated by

the second hand of the user is a wire rod.

25. The method of Claim 20, further comprising:

controlling operation of the torch independent of the filler material source.